Research Note 80-24

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EXPERIMENTAL INVESTIGATION OF NEAR REAL-TIME INTERPRETATION TECHNIQUES FOR TRANSMITTED IMAGERY

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Eight interpretation concepts such as might be utilized at a ground terminal in conjunction with the handling of transmitted imagery were simulated. Four were one-man concepts while the other four utilized two-man teams viewing the imagery in sequence. The one-man concepts were formulated around different combinations of the elements of availability of film speed control, viewing area, and methods of target designation and location reporting. The two-man concepts differed on the availability of speed control and the decision criteria for the initial man of the team and the associated rescreening

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strategy of the second man of the team. Military image interpreters detected, identified, and reported targets on the imagery, presented on motorized light table under two film input rates, utilizing the conditions of the various experimental interpretation concepts. Interpretation performance was found to be influenced by the size of the viewing area and the use of a magnifying reticle to localize targets, in the one man concepts. The incorporation of the speed control option did not significantly affect performance. Provision for control of film movement or differential emphasis on accuracy or completeness had no significant effects in the two-man concepts.

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FOREWORD

This Research Note, "Experimental Investigation of Near Real-Time Interpretation Techniques for Transmitted Imagery," was accomplished through a joint effort between Thomas Ray and Robert King of HRB-Singer, Inc., and Dr. Marshall Narva of ARI. This report, recently declassified, was completed under Army Project Number 2Q662704A732.

This report reflects the research accomplished in differing photo interpretation concepts; one- and two-man concepts involved in different combinations of film speed control, viewing area and methods of target designation and location reporting.

EXPERIMENTAL INVESTIGATION OF NEAR REAL-TIME INTERPRETATION TECHNIQUES FOR TRANSMITTED IMAGERY

BRIEF

Requirement:

To obtain performance data on the relative effectiveness of selected concepts for the interpretation of infrared imagery under near real-time viewing conditions.

Eight interpretation concepts were tested under two conditions of base film input rate (.5 and 1.0 inch per second). Four were one-man concepts while the other four utilized two men viewing the imagery in sequence. The one-man concepts were formulated around different combinations of the elements of film speed control (available or not available), viewing area (10 inches or 20 inches), target designation method (marking on film or input via pushbutton keyboard), and location reporting of target (none, verbal report of marginally noted UTM coordinates, or superposition of a reticle). The two-man concepts differed on the availability of speed control and the decision criteria for the initial man of the team and the associated rescreening strategy of the second man of the team. Forty-eight image interpreters were used as subjects.

Findings:

When throughput time is not considerd, no significant differences were found between the one-man concepts with the exception that misidentifications were reduced either with the use of the 10-inch window, due to a tendency to report only those targets identified with certainty, or with the use of a magnifying reticle to localize targets.

The time required to utilize a reticle to localize a target caused a significant decrease in efficiency with respect to detection accuracy and completeness achieved per unit time, but identification performance achieved per unit time, as compared with other concepts involving a location reporting task, did not differ significantly.

The incorporation of the speed control option over the film did not significantly affect performance, with or without time lag taken into account.

Provision for control of film movement or differential emphasis on accuracy or completeness had no significant effects in the two-man concepts; no significant differences being found among these concepts.

Utilization of Findings:

Based on the conditions utilized in the present study, it would appear that use of a larger viewing surface (20 inches as opposed to 10 inches) would permit a location reporting task based on marginal notations to be performed in addition to target identification without requiring film speed control and associated time lag. With a 20-inch window, no advantage appears to have been demonstrated for provision for film speed control.

The utilization of a reporting procedure incorporating the placement of a reticle over the target permits accuracy of location and a suppression of misidentifications due to the magnifying property of the reticle. However, the procedure inherently involves a time lag, which may prove significant relative to other less accurate procedures.

Based on the conditions utilized in the present study, there were no indications of benefits in performance with the two-man concepts as compared with the one-man concepts. However, further investigation is required into other possible procedures, both for the one-man as well as for the two-man concepts.

EXPERIMENTAL INVESTIGATION OF NEAR REAL-TIME INTERPRETATION TECHNIQUES FOR TRANSMITTED IMAGERY

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Tables (continued)

FIGURES

EXPERIMENTAL INVESTIGATION OF NEAR REAL-TIME INTERPRETATION TECHNIQUES FOR TRANSMITTED IMAGERY

THE PROBLEM

With recent improvements in military firepower and mobility there is an ever-increasing requirement for more timely information to be provided to the tactical commander so that he may act or react as expeditiously as possible. For this purpose, the Army has defined a requirement for the rapid acquisition of imagery for interpretation to provide decision-oriented intelligence information as rapidly as possible. Thus, a real-time electronic data link system that relays sensor-acquired data to the ground for immediate processing is envisioned for the Army's organic collection capability. Such a system would transmit acquired infrared (IR) and side-looking airborne radar (SLAR) signals to the ground for rapid processing at a ground sensor terminal. In this manner, a significant delay -- that between the acquisition of aerial imagery and its processing on the ground after the aircraft has returned -- will be practically eliminated. The only delay prior to interpretation will be in film processing, which will be very short using state-of-the-art rapid film processing techniques. Interpreters will have the opportunity to interpret imagery in near real-time and to provide an intelligence product for further analysis with a minimum of delay.

Conventional interpretation techniques and procedures, however, may not permit satisfactory interpretation of this imagery in near real-time. To keep the time from receipt of the imagery to the dissemination of the resultant report to a minimum, new techniques and procedures must be developed to insure the required timeliness and to provide information that is as complete and accurate as possible.

Extensive research has studied selected interpreter techniques for photographic image interpretation. Studies of screening procedures and of team interpretation techniques have indicated how system effectiveness can be increased through the improvement of interpreter techniques. There is the need, however, to validate applicable findings of prior research concerning photointerpretation for the interpretation of imagery from other sensors. Moreover, techniques more directly related to the data-linked ground sensor terminal need to be evolved and tested.

The purpose of this study was to conceptualize a number of promising interpretation concepts for deriving intelligence information in near real-time, and to test these concepts under load. Specifically, four one-man and four two-man concepts were tested, each under two levels of film input rate.

THE METHOD

Subjects

Forty-eight image interpreters served as subjects. Forty were new graduates of the U.S. Army Intelligence School, Image Interpretation course at Fort Huachuca, Arizona. The remaining eight were more experienced, having been operationally asigned as image interpreters. The experienced interpreters were distributed randomly to the treatment conditions.

Subject Preparation

Subjects participated in two preparatory sessions prior to the conduct of the experiment. The first was a general session with the objective of providing all subjects with baseline skills in infrared signatures, detection, and identification. This session was practically oriented and emphasized exposure to the target signatures that would appear in the experiment. The training was conducted on a small group basis and began with descriptions and examples of each target type to be seen in the experiment. Subjects next went through a roll of imagery which was similar in format to the test roll. This roll was viewed in a static mode and the subjects were allowed as much time as they wished to study the targets in each segment. The total time for this session was approximately one hour.

The second session was more specific to the experiment and began with the postulation of a data link ground station and the requirements levied on an interpreter working in such a situation. This setting was used to explain the study objectives and to give examples of near real-time interpretation. Subjects were instructed on procedures for controlling film movement rate, target marking, and reporting procedures, then they were allowed to practice on the light table until they felt comfortable working with moving film in the simulated near real-time condition and until the experimenter judged that they could perform the required tasks.

Immediately prior to each experimental session detailed instructions were given to the subject concerning his tasks for that session, the procedures to be used in reporting targets, and whether he was to have the capability for controlling the film movement.

Appartus

Testing was conducted in the ARI Information Systems Laboratory using the ARI automated light tables. Figure 1 shows one of these tables configured for the experiment. They are specialized pieces of experimental appartus designed for interpreter research and have the capability of communicating with a computer.

This computer link was used to record subject responses under certain types of the experimental conditions. The responses of target type and number of targets were entered through a forty-button response panel (Figure 2). Buttons on this panel were also used to control the film start-stop capability and the film movement rate. Target location in terms of X and Y coordinates could be reported (in the automated conditions) by first performing an initialization task and then positioning the reticle of the light table cursor over the target on the film and activating a foot switch. In conditions requiring verbal reporting, a standard audio tape recorder and microphone were used to rcord subject responses.

FIG. 1 AUTOMATED LIGHT TABLE CONFIGURED FOR NEAR REAL-TIME EXPERIMENT

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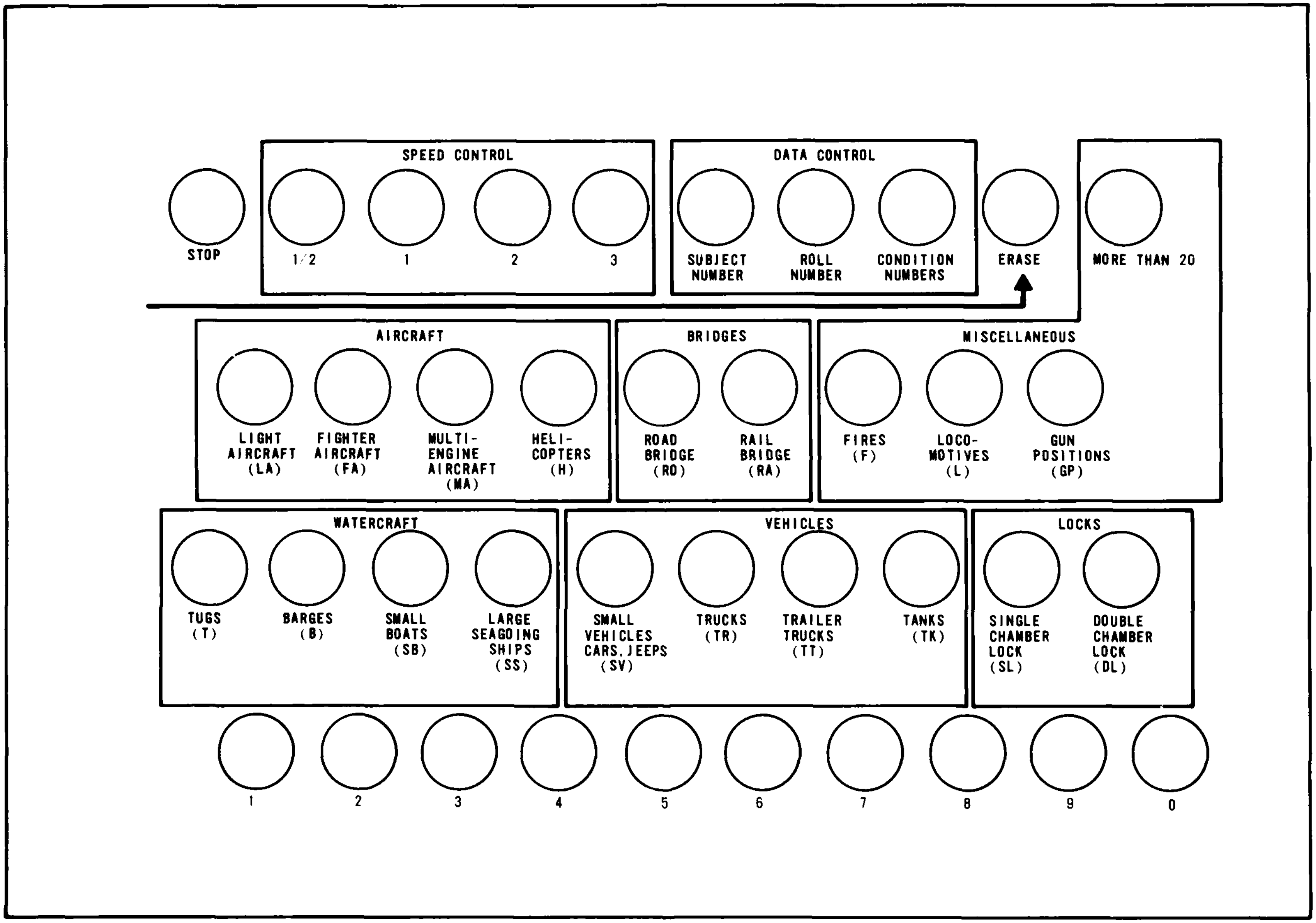

FIG. 2 LIGHT TABLE CONTROL PANEL LAYOUT

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Imagery

Three rolls of infrared line scan transparencies were used. Each roll consisted of segments of imagery which were in the 5-inch format. A representation of an image segment is shown in Figure 3. All imagery was acquired under nighttime conditions and was presented in a negative format. At the beginning of each frame, instructions were printed which specified an area on the imagery to which the interpreter was to direct his search and the type(s) of target to be reported. In some cases the task was confined to a single specific area such as a road or canal and was limited to a single target class. In other cases the entire image was to be viewed for targets and all target classes (as defined on the target list) were to be reported. The targets included the general classes of aircraft, bridges, watercraft, vehicles, locks and a miscellaneous category. The complete target list is shown in Table 1. A detailed listing of the tasks and targets in each image segment along with the altitude under which the segment was acquired is contained in Appendix A.

The test rolls were annotated with a series of six-digit coordinates used to simulate a readout of UTM coordinates. These coordinates were used, in certain conditions, to indicate target location. The coordinates were spaced every five inches along the bottom margin of the film to be consistent with current Army marginal notation practices.

Each test roll was also given a set of serial numbers which, in conjunction with a digital counter, were used to pace subjects and to reinforce the concept that timeliness was important in the experiment. These numbers were placed every 18 inches along the top of the roll of imagery. The counter was set so that for a given speed condition the number appearing on the counter would be the same as the number in front of the subject as long as the film was not stopped. If the film was stopped, the number on the film fell behind that on the counter and the subject knew that he was working at less than the basic speed. Subjects were instructed to work as rapidly as they could and that if they fell behind the basic counter speed they should try to catch up. They were not allowed to work at a rate faster than the counter.

Experimental Procedures

An analysis of alternative system concepts for near real-time interpretation was performed which considered the findings of previous image interpretation studies and the characteristics of present and planned Army interpretation facilities. A developmental data link system for near real-time interpretation was studied along with the projected characteristics of an advanced tactical image interpretation facility. This analysis resulted in the formulation of eight interpretation concepts for experimentation. These team/operational concepts were designed as integrated units within which a number of elements were varied. These elements were -

<u>Speed Control</u> -- This factor was the ability of the interpreter to control and stop the film movement rate. Two levels of this variable were used; constant film rate where no control could be exercised over the film, and variable where the film could be stopped or run at any of four speeds. If the

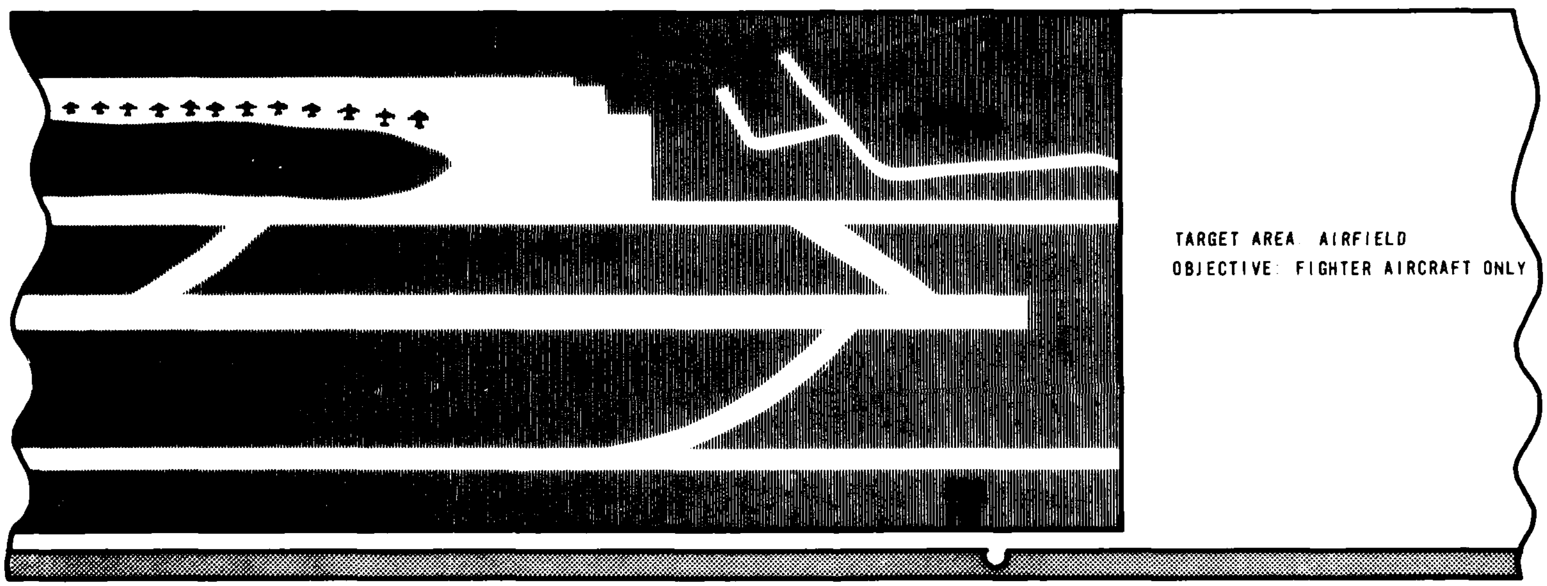

FIG. 3 REPRESENTATION OF AN IMAGE SEGMENT

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TABLE 1 NEAR REAL-TIME TARGET LIST

AP14315

AIRCRAFT	VEHICLES
LA LIGHT AIRCRAFT	SV SMALL VEHICLES
FA FIGHTER AIRCRAFT	TR TRUCKS
MA MULTI-ENGINE AIRCRAFT	TT TRAILER TRUCKS
H HELICOPTERS	TK TANKS
BRIDGES	**LOCKS**
RO ROAD BRIDGE	SL SINGLE CHAMBER LOCK
RA RAIL BRIDGE	DL DOUBLE CHAMBER LOCK
WATERCRAFT	**MISCELLANEOUS**
T TUGS	F FIRES
B BARGES	L LOCOMOTIVES
SB SMALL BOATS	
SS LARGE SEAGOING SHIPS	GP GUN POSITIONS

subject was working at a base speed of .5 inch per second, he had the option of using the basic .5 inch per second or speeding up to 1.0, 2.0, or 3.0 inches per second. When operating at a basic speed of 1.0 inch per second, the subject could slow to .5 inch per second or increase the film rate to 2.0 or 3.0 inches per second.

Viewing Area -- Two different viewing surface widths were used; 10 inches and 20 inches. The 10-inch surface was consistent with the film window in a processor-viewer, and the 20--inch surface was a projection of what would be used in future Army interpretation equipment.

Detection and Identification -- Detection was the process of indicating the presence of a target. Identification was the procedure of assigning a target class descripter to the detected object. Detections were indicated in two ways: In the physical marking method the target was circled on the imagery with a grease pencil and the identification marked next to the target. Subjects made no discrete "detection" response in the automated method but instead the fact that a target, regardless of type, was reported at a given location was considered a detection. In the physical marking method, scores were derived from the subject's annotations on the imagery. In the automated method, paper printouts were made of subject inputs made through the forty-button response panel.

Coordinate Location -- This was the task of reporting the location of a target in X and Y values. Three conditions were used here. In the first method no location task was required. A second method was a verbal report where the interpreter ascribed target location by reading the closest six digit coordinate from the margin of the image, and finally an automated method which computed X and Y values for targets using the automated light table's coordinate measurement feature.

Decision Criteria -- Decision criteria were the rules by which subjects were instructed to determine whether targets should be reported. In all one-man conditions, instructions were given to maintain a balance between accuracy and completeness. In the two-man conditions, instructions were given to the first man to be either as accurate or as complete as possible. Instructions emphasizing accuracy directed the subject to select only those targets which they felt definitely were targets. Completeness instructions stated that all possible targets should be reported even if some selections were errors.

Rescreening -- The rescreening task was performed by the second man in the two-man conditions and was related to the completeness and accuracy instructions given to man 1. In conditions where accuracy was stressed for the first man, the second man was instructed to check the first man's detections and identifications and also to rescreen the entire length of imagery for additional targets. In conditions stressing completeness to man 1, the man 2 task was only to check the detections and identifications made by the first man.

Table 2 shows the characteristics of the eight configurations selected for experimentation with the factor of task distribution broken into one- and two-man teams.

TABLE 2 DEFINITION OF NEAR REAL-TIME TREATMENT CONDITIONS

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	VARIABLES	A	B	C	D
ONE-MAN CONDITIONS	SPEED CONTROL	CONSTANT	CONSTANT	VARIABLE	VARIABLE
	VIEWING AREA	10 INCHES	20 INCHES	20 INCHES	20 INCHES
	DETECTION	CIRCLE	CIRCLE	CIRCLE	AR
	IDENTIFICATION	ANNOTATION	ANNOTATION	ANNOTATION	AR
	COORDINATE LOCATION	NONE	VERBAL REPORT	VERBAL REPORT	AR
	DECISION CRITERIA	COMPLETENESS AND ACCURACY			

AR = AUTOMATED REPORT

		VARIABLES	E	F	G	H
TWO-MAN CONDITIONS	MAN 1*	SPEED CONTROL	CONSTANT	CONSTANT	VARIABLE	VARIABLE
	MAN 1*	DECISION CRITERIA	ACCURACY	COMPLETENESS	ACCURACY	COMPLETENESS
	MAN 2**	COMPLETELY RESCREEN	YES	NO	YES	NO

* IN ALL CONDITIONS MAN 1 CIRCLED AND ANNOTATED TARGETS.

** IN ALL CONDITIONS MAN 2 HAD VARIABLE SPEED CONTROL, COMPLETED AND VERIFIED ANNOTATIONS OF MAN 1 AND FILED AN AUTOMATED REPORT OF THE LOCATION AND IDENTITY OF TARGETS HE VERIFIED OR DETECTED THROUGH RESCREENING.

Concept A was a simulation of the capabilities of a processor-viewer which provides a 10-inch long access window through which an interpreter can view the film after it is processed. The interpreter had no control over film movement in this condition. The environment in which such a system was envisioned was where an operator would be tasked with performing an initial brief interpretation as the imagery was being processed.

Concept B was configured as an idealized film processor, where the viewing surface was a full 20 inches, however, the interpreter still had no control over film movement. In this condition the interpreter was tasked with providing target location information using the marginal coordinates. Overall, this concept simulated a situation where the interpreter working at a processor was in radio contact with strike aircraft and would issue reports on targets as they were detected and identified.

Concept C again was an idealized film processor station with the interpreter isssuing verbal reports. This concept differed from Concept B only in that the interpreter had control over film movement.

Concept D was constructed around an advanced situation with the features of variable speed control, a 20-inch viewing surface and automatic report generation through a programmed keyboard.

Concepts E and F were two-man configurations where the first man worked at a film processor with no control over film movement rate and was tasked with scanning the film and making whatever detections and identifications he could. Man 2 in both these configurations had control over film movement and had the task of filing an automated report of the location, type, and number of targets found on the imagery. The concepts differed in the decision-making criteria given man 1, (E emphasized accuracy and F emphasized completeness) and whether the task of rescreening was required of man 2 (in E, man 2 rescreened the entire imagery, in F he did not).

Concepts G and H were similar to Concepts E and F with the exception that in G and H the capability of controlling film speed was given to the first man. Decision criteria, viewing surface and the assignment of the rescreening task remained the same.

Subjects worked in pairs, with each subject participating in a one-man condition and in both the first man and second man positions of a two-man condition. This was accomplished by utilizing the three rolls of imagery so that each subject saw each roll of imagery once and each roll of imagery was used an equal number of times in each treatment condition. Both subjects used the same roll of imagery for the one-man condition. Each used a different roll for the man 1 condition of the team configuration. After completing the man 1 task, subjects exchanged rolls of imagery and then worked in the man 2 condition with the imagery screened by his partner. Half of the subjects participated in the one-man condition first, and the other half received the two-man condition first. Since the task and response procedures differed for each of the three conditions, instructions were read immediately prior to each condition. Instructions given for each of the eight conditions are included as Appendix B.

The eight interpretation concepts were tested under two conditions of film input rate, .5 inch per second and 1.0 inch per second. These input rates simulated film coming from the ground processor of a data link system and related to mission altitude and speed parameters of a hypothetical reconnaissance aircraft. In real life this would mean that in conditions where subjects had no control over the film speed, they would work at the same speed as the film was being acquired (with a delay for processing). In conditions where subjects had stop and speed control capabilities, this would mean that the processing apparatus would have the capability of accumulating film at the input rate whenever the subject slowed or stopped the film on the light table. The following flight parameters would equate to the two input rates used.

Altitude (Ft.)	.5 ips	1.0 ips
1,000	108.5 Knots	217 Knots
1,500	163 Knots	326 Knots
2,000	217 Knots	434 Knots

Experimental Design

Two separate 4 x 2 factorial designs were used; one testing the four one-man concepts, and the other testing the four two-man concepts. Two levels of film input rate were examined in each design (.5 inch per second and 1.0 inch per second). In the one-man design each cell contained six subjects. The two-man analysis had six two-man teams per cell. The subject assignment schedule is shown in Table 3. Distribution of the subjects across the two designs was made so that within each cell of the one-man design, an equal number of subjects from each cell in the two-man design were allocated. Conversely, each two-man cell contained two subjects from each of the one-man cells. Each of the three rolls of test imagery was used twice in each experimental condition. The presentation of test imagery to the subjects was arranged so that each subject saw each roll only once.

Performance Measures

The following evaluations of interpreter performance were applied in assessing the effects of the independent variables:

Detection Accuracy -- the percentage of correct target detections out of the total responses.

$$\frac{R + M}{R + M + I} \times 100$$

where: R = number of targets correctly detected and identified

M = number of targets correctly detected but misidentified.

I = number of false detections.

TABLE 3 SUBJECT ASSIGNMENT SCHEDULE

AP14314

SUBJECT NUMBER	FILM SPEED	ONE-MAN TREATMENT		TWO-MAN TREATMENT		
		CONDITION	ROLL	CONDITION	MAN 1 ROLL	MAN 2 ROLL
1	0.5	A	I	E	II	III
2	1.0	A	I	F	II	III
3	0.5	A	I	G	II	III
4	1.0	A	I	H	II	III
5	0.5	A	II	E	I	III
6	1.0	A	II	F	I	III
7	0.5	A	II	G	I	III
8	1.0	A	II	H	I	III
9	0.5	A	III	E	I	II
10	1.0	A	III	F	I	II
11	0.5	A	III	G	I	II
12	1.0	A	III	H	I	II
13	1.0	B	I	E	II	III
14	0.5	B	I	F	II	III
15	1.0	B	I	G	II	III
16	0.5	B	I	H	II	III
17	0.5	B	II	E	I	III
18	1.0	B	II	F	I	III
19	0.5	B	II	G	I	III
20	1.0	B	II	H	I	III
21	1.0	B	III	E	I	II
22	0.5	B	III	F	I	II
23	0.5	B	III	G	I	II
24	1.0	B	III	H	I	II
25	0.5	C	I	E	III	II
26	1.0	C	I	F	III	II
27	0.5	C	I	G	III	II
28	1.0	C	I	H	III	II
29	1.0	C	II	E	III	I
30	0.5	C	II	F	III	I
31	1.0	C	II	G	III	I
32	0.5	C	II	H	III	I
33	0.5	C	III	E	II	I
34	1.0	C	III	F	II	I
35	1.0	C	III	G	II	I
36	0.5	C	III	H	II	I
37	1.0	D	I	F	III	II
38	0.5	D	I	F	III	II
39	1.0	D	I	G	III	II
40	0.5	D	I	H	III	II
41	0.5	D	II	E	III	I
42	1.0	D	II	F	III	I
43	0.5	D	II	G	III	I
44	1.0	D	II	H	III	I
45	1.0	D	III	E	II	I
46	0.5	D	III	F	II	I
47	0.5	D	III	G	II	I
48	1.0	D	III	H	II	I

Identification Accuracy -- the percentage of correct target identifications out of the total responses.

$$\frac{R}{R + M + I} \times 100$$

Detection Completeness -- the percentage of targets correctly detected out of the total available.

$$\frac{R + M}{T} \times 100$$

where: T = total possible valid targets.

Identification Completeness -- the percentage of targets correctly identified out of the total available.

$$\frac{R}{T} \times 100$$

Correctness -- the percentage of targets correctly identified out of those correctly detected.

$$\frac{R}{R + M} \times 100$$

Time -- the elapsed time in minutes to complete each roll of imagery.

RESULTS

Mean scores for the performance measures, except time, are presented in Table 4 for the one-man concepts and in Table 5 for the two-man concepts. Mean elapsed time measures are presented in Table 6*. Efficiency scores calculated by dividing the various performance measures by the elapsed times are presented in Table 7 for the one-man concepts and in Table 8 for the two-man concepts.

Analyses of variance were performed on the performance measures and the efficiency scores. In addition, because of the interest in the possible significant differences between the various concepts, Duncan's New Multiple Range Tests were applied to the mean performance and efficiency scores for both the one-man and the two-man concepts. The results of the analyses of variance and the Duncan's tests are presented in Appendix C.

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* In the case of the two-man concepts, a composite time measure was utilized consisting of the elapsed time for Man 2 plus the "lag" time for Man 1. "Lag" time for Man 1 is defined as the difference between actual elapsed time and a potential elapsed time based upon film input speed.

TABLE 4 MEAN SCORES - ONE-MAN CONCEPTS

TABLE 4a. DETECTION ACCURACY

FILM SPEED	INTERPRETATION CONCEPT				
	A	B	C	D	
.5 IPS	84.42	85.11	89.07	81.04	84.91
1.0 IPS	84.93	88.03	90.51	86.73	87.55
	84.67	86.57	89.79	83.89	86.23

TABLE 4b. IDENTIFICATION ACCURACY

FILM SPEED	INTERPRETATION CONCEPT				
	A	B	C	D	
.5 IPS	73.77	70.34	70.72	69.37	71.05
1.0 IPS	66.65	57.02	67.17	79.80	67.66
	70.21	63.68	68.94	74.59	69.36

TABLE 4c. DETECTION COMPLETENESS

FILM SPEED	INTERPRETATION CONCEPT				
	A	B	C	D	
.5 IPS	58.99	54.83	57.97	57.74	57.38
1.0 IPS	55.82	47.63	47.54	42.46	48.36
	57.40	51.23	52.76	50.10	52.87

TABLE 4d. IDENTIFICATION COMPLETENESS

FILM SPEED	INTERPRETATION CONCEPT				
	A	B	C	D	
.5 IPS	51.43	45.51	46.74	48.49	48.04
1.0 IPS	44.01	31.26	34.56	39.00	37.21
	47.72	38.38	40.65	43.74	42.62

TABLE 4e. CORRECTNESS

FILM SPEED	INTERPRETATION CONCEPT				
	A	B	C	D	
.5 IPS	87.39	82.30	79.06	86.03	83.70
1.0 IPS	79.79	64.46	74.52	91.87	77.66
	83.59*	73.38	76.79	88.95*	80.68

*A>B; D>B,C (P<.05)

TABLE 5 MEAN SCORES - TWO-MAN CONCEPTS

TABLE 5a. DETECTION ACCURACY

FILM SPEED	INTERPRETATION CONCEPT				
	E	F	G	H	
.5 IPS	84.42	77.98	86.84	84.62	83.46
1.0 IPS	81.83	82.26	83.50	86.97	83.64
	83.13	80.12	85.17	85.80	83.55

TABLE 5b. IDENTIFICATION ACCURACY

FILM SPEED	INTERPRETATION CONCEPT				
	E	F	G	H	
.5 IPS	72.86	65.91	74.60	72.64	71.50
1.0 IPS	63.62	71.90	69.20	75.39	70.03
	68.24	68.90	71.90	74.02	70.77

TABLE 5c. DETECTION COMPLETENESS

FILM SPEED	INTERPRETATION CONCEPT				
	E	F	G	H	
.5 IPS	60.39	58.17	64.80	57.28	60.16
1.0 IPS	45.06	44.21	46.93	49.91	46.53
	52.73	51.19	55.87	53.60	53.35

TABLE 5d. IDENTIFICATION COMPLETENESS

FILM SPEED	INTERPRETATION CONCEPT				
	E	F	G	H	
.5 IPS	52.26	49.20	55.51	49.00	51.49
1.0 IPS	34.82	38.47	38.26	42.90	38.61
	43.54	43.83	46.88	45.95	45.05

TABLE 5e. CORRECTNESS

FILM SPEED	INTERPRETATION CONCEPT				
	E	F	G	H	
.5 IPS	86.67	84.34	85.77	86.20	85.74
1.0 IPS	78.18	87.02	82.57	86.84	83.65
	82.42	85.68	84.17	86.52	84.70

TABLE 6 TIME MEANS

TABLE 6a. ONE-MAN TIME MEANS (MINUTES)

FILM SPEED	INTERPRETATION CONCEPT				MEANS
	A	B	C	D	
.5 IPS	44.00	44.00	46.83	50.33	46.29
1.0 IPS	22.00	22.00	24.50	34.16	25.66
MEANS	33.00	33.00	35.66	42.24	35.97

TABLE 6b. TWO-MAN COMPOSITE TIME MEANS * (MINUTES)

FILM SPEED	INTERPRETATION CONCEPT				MEANS
	E	F	G	H	
.5 IPS	53.50	48.00	50.00	46.50	49.50
1.0 IPS	33.16	31.66	39.00	41.50	36.33
MEANS	43.33	39.83	44.50	44.00	42.91

* COMPOSITE TIME CONSISTED OF THE ELAPSED TIME FOR MAN 2 PLUS THE LAG TIME FOR MAN 1. LAG TIME FOR MAN 1 IS DEFINED AS THE DIFFERENCE BETWEEN ACTUAL ELAPSED TIME AND A POTENTIAL ELAPSED TIME BASED UPON FILM INPUT SPEED.

TABLE 7 EFFICIENCY (MEAN SCORES TIME) - ONE-MAN CONCEPTS

TABLE 7A DETECTION ACCURACY*

FILM SPEED	INTERPRETATION CONCEPT				
	A	B	C	D	
.5 IPS	1.91	1.95	1.91	1.66	1.86
1.0 IPS	3.85**	4.01**	3.75**	2.56	3.54
	2.88	2.98	2.83	2.11	2.70

**A>D, B>D, C>D (P<.05)

TABLE 7B IDENTIFICATION ACCURACY

FILM SPEED	INTERPRETATION CONCEPT				
	A	B	C	D	
.5 IPS	1.67	1.62	1.51	1.43	1.56
1.0 IPS	3.02	2.59	2.76	2.36	2.68
	2.35**	2.11	2.13	1.89	2.12

**A>D (P<.05)

TABLE 7C DETECTION COMPLETENESS***

FILM SPEED	INTERPRETATION CONCEPT				
	A	B	C	D	
.5 IPS	1.33	1.25	1.23	1.12	1.23
1.0 IPS	2.49**	2.17**	1.98**	1.25	1.97
	1.91	1.71	1.60	1.18	1.60

**A>D, B>D, C>D (P<.05)

TABLE 7D IDENTIFICATION COMPLETENESS

FILM SPEED	INTERPRETATION CONCEPT				
	A	B	C	D	
5 IPS	1.16	1.04	.99	.94	1.03
1.0 IPS	1.97	1.42	1.43	1.15	1.49
	1.56*	1.23	1.21	1.05	1.26

**A>B, C, D (P<.05)

TABLE 7E CORRECTNESS

FILM SPEED	INTERPRETATION CONCEPT				
	A	B	C	D	
.5 IPS	1.99	1.88	1.69	1.76	1.83
1.0 IPS	3.65	2.94	3.05	2.71	3.08
	2.82**	2.41	2.37	2.23	2.46

**A>B, C, D (P<.05)

*INTERPRETATION CONCEPT X FILM SPEED INTERACTION SIGNIFICANT (P<.01)
***INTERPRETATION CONCEPT X FILM SPEED INTERACTION SIGNIFICANT (P<.05)

TABLE 8 EFFICIENCY (MEAN SCORES TIME) - TWO-MAN CONCEPTS

TABLE 8a. DETECTION ACCURACY

FILM SPEED	INTERPRETATION CONCEPT				
	E	F	G	H	
.5 IPS	1.62	1.63	1.80	1.82	1.72
1.0 IPS	2.79	2.73	2.53	2.61	2.66
	2.20	2.18	2.17	2.22	2.19

TABLE 8b. IDENTIFICATION ACCURACY

FILM SPEED	INTERPRETATION CONCEPT				
	E	F	G	H	
.5 IPS	1.40	1.38	1.55	1.56	1.47
1.0 IPS	2.17	2.38	2.13	2.22	2.22
	1.78	1.88	1.84	1.89	1.85

TABLE 8c. DETECTION COMPLETENESS

FILM SPEED	INTERPRETATION CONCEPT				
	E	F	G	H	
.5 IPS	1.18	1.21	1.35	1.22	1.24
1.0 IPS	1.52	1.47	1.43	1.53	1.48
	1.35	1.34	1.39	1.38	1.36

TABLE 8d. IDENTIFICATION COMPLETENESS

FILM SPEED	INTERPRETATION CONCEPT				
	E	F	G	H	
.5 IPS	1.02	1.02	1.16	1.05	1.06
1.0 IPS	1.17	1.27	1.18	1.29	1.23
	1.10	1.14	1.17	1.17	1.14

TABLE 8e. CORRECTNESS

FILM SPEED	INTERPRETATION CONCEPT				
	E	F	G	H	
.5 IPS	1.65	1.77	1.78	1.87	1.77
1.0 IPS	2.67	2.90	2.53	2.56	2.66
	2.16	2.33	2.16	2.21	2.22

One-Man Concepts

When time was not taken into account no significant effects for the one-man concepts were found except for the Correctness measure, (the proportion of correct identifications to correct detections). The Duncan test indicated that Concept A yielded significantly better performance on this measure than Concept B and Concept D gave significantly better performance than either B or C. The superiority of Concept A over B may be attributed to the tendency of subjects in the A condition, which involved a constantly moving film moving past a 10-inch window, to report (annotate) only those targets which they could identify with a high degree of certainty, due to the constrained viewing time available. The superiority of Concept D over Concepts B and C may be attributed to the use of the magnifying glass incorporated into the coordinate locator. Although similar magnifying glasses were available in the other conditions, in the case of Concept D, the subject was forced to view the target through the glass in order to report its location. This would tend to reduce the number of mis-identifications made.

No significant differences were found on the performance measures between Concepts B and C which differed only in that Concept C gave the subject the ability to manipulate the speed of the film, or to stop it.

No interactions between base film speed and concept were found for the performance measures.

When time was taken into account, in the efficiency scores (the performance measures divided by the elapsed time scores), the following significant differences were found by the Duncan's tests:

Detection Accuracy [1]	A>D, B>D, C>D
Identification Accuracy	A>D
Detection Completeness[1]	A>D, B>D, C>D
Identification Completeness	A>B, A>C, A>D
Correctness	A>B, A>C, A>D

As may be seen by reference to Table 6, Concept C required on the average 2.5 more minutes to complete the task than was the case for the concepts (A and B) in which the subject had no option to control the speed of the film. Therefore, a lag or delay of 2.5 minutes behind the mission time line was experienced. In contrast to the lag involved in the utilization of Concept C, Concept D had an average lag in reporting time of nine minutes. Much of this additional time may be attributed to the time required to initialize and then position the reticle and to utilize the pushbuttons to perform the reporting task.

The additional time involved in utilizing Concept D produced a significant penalty in terms of efficiency for Concept D, as seen in Table 7. The time required caused Concept D to be significantly inferior to all other one-man concepts with respect to detection accuracy and completenes and to Concept A

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1 The analyses of variance indicated a significant concept X film speed interaction in the case of Detection Accuracy and Detection Completeness, thus the Duncan test was performed for both levels of film speed. Significance was produced only in the case of the 1.0 inch per second rate.

(but not Concepts B or C) with respect to identification accuracy, identification completeness, and correctness. Concept C, while utilizing much less time than D, also proved to be significantly inferior to Concept A in terms of efficiency relative to identification completeness and correctness.

In comparing the two conditions (C and D) in which the subject had control over film movement, C was superior in terms of detection efficiency, but they were equivalent relative to identification efficiency, indicating that the time lag of D was compensated for by the enhanced identification performance under this condition, as discussed previously.

In comparing the two fixed time conditions, A and B, Concept A was superior to B in terms of identification completeness and correctness efficiency. Since the time factor was constant between the two, the difference must be attributable to the superior standing of A on these measures. As indicated previously, it appears that in working in Concept A, there was a tendency to report only those targets that could be identified with a high degree of certainty, leading to a low misidentification rate. This is reflected in the superior standing of A relative to B on both the correctness performance measures and efficiency scores. This effect emerged for identification completeness also when incorporated into the efficiency score. This factor also entered into the superiority of A over C and D in efficiency.

In Concept B, the task of the subject involved giving a verbal identification and location report. In contrast to Concept A, which has a 10-inch window, Concept B had a 20-inch window. However, the reporting task appears to have offset any possible advantage of an enlarged window, as performance on this concept was equivalent or inferior to that on Concept A. This was also the case with Concept C, which in addition incorporated control over the film. (Without the enlarged window, the execution of the verbal reporting task may have led to significantly degraded performance.)

In comparing Concepts B and C, which differed only with respect to providing the option to the subject of controlling the film movement, as was found with the performance measures, no differences between these two concepts were found on the efficiency scores, indicating that the incorporation of this control capability did not significantly affect performance either with or without time taken into account.

Two-Man Concepts

No significant differences were found among the two-man concepts either for the performance measures or the efficiency scores. As found in the one-man conditions, the incorporation of the capability to control film movement for the initial screening did not have a significant effect on team output. The differential emphasis on accuracy or completeness also failed to emerge as a significant influence.

In comparing the average performance obtained with the two-man concepts and the one-man concepts it appears that they are similar. Further, the average through-put time for the two-man concepts, which involved the use of the reticle for location reporting, was similar to that for the one-man concept. Therefore, there was no benefit in performance nor a loss in efficiency as may be seen by comparing the average efficiency scores on Table 7 for the one-man concepts with those on Table 8 for the two-man concepts.

CONCLUSIONS

When through-put time is not considered, no significant differences were found between the one-man concepts evaluated with the exception that misidentifications were reduced in the concept involving the 10-inch window (due to a tendency to report only those targets identified with certainty), and in the concept in which the subject had to utilize a magnifying glass to make his report.

With no control over film movement, no significant difference in performance was found with the addition of a verbal identification and location reporting task with a 20 inch viewing window as compared with performing a screening task with no reporting utilizing a 10 inch window.

No difference in performance was caused by giving the option to the subject of controlling or stopping the movement of the film. However, an average lag of two minutes was experienced in through-put time, indicating that this use of this capability may not prove to be efficient.

The utilization of a reporting procedure incorporating the placement of a reticle over the target produces accuracy of location not possible with the reading of a marginal notation and a suppression of misidentifications due to the utlization of the reticle. However, the time involved in the utilization of such a reporting procedure with loss in efficiency must be considered.

Provision for control of film movement or differential emphasis on accuracy or completeness had no significant effects in the two-man concepts, as reflected in no significant differences being found between these concepts.

There were no indications of any benefits in performance or efficiency with the two-man concepts as compared to the one-man concepts.

APPENDIX A

DESCRIPTION OF TEST IMAGERY

APPENDIX A DESCRIPTION OF TEST IMAGERY ROLL 1

SEGMENT LENGTH IN FEET	TASK DESCRIPTION		ALTITUDE
0.9	TARGET AREA:	GENERAL TERRAIN	2000 FT.
	OBJECTIVE:	BRIDGES	
0.9	TARGET AREA:	AIRFIELD	2000 FT.
	OBJECTIVE:	ALL AIRCRAFT	
1.8	TARGET AREA:	BEACH	2000 FT.
	OBJECTIVE:	FIRES	
8.3	TARGET AREA:	RIVER	2000 FT.
	OBJECTIVE:	UNMOORED SEAGOING SHIPS	
1.4	TARGET AREA:	RAIL	2000 FT.
	OBJECTIVE:	LOCOMOTIVES	
0.8	TARGET AREA:	RAIL	2000 FT.
	OBJECTIVE:	LOCOMOTIVES	
7.5	TARGET AREA:	RIVER	2000 FT.
	OBJECTIVE:	ALL MOVING WATER CRAFT	
5.2	TARGET AREA:	HIGHWAY	2000 FT.
	OBJECTIVE:	ALL VEHICLES	
19.9	TARGET AREA:	WATERWAY RAIL	2000 FT.
	OBJECTIVE:	TUGS, BARGES, SEAGOING SHIPS, LOCOMOTIVES	
4.6	TARGET AREA:	RAIL	1000 FT.
	OBJECTIVE:	LOCOMOTIVES	
4.9	TARGET AREA:	GENERAL TERRAIN	1000 FT.
	OBJECTIVE:	BRIDGES	
3.9	TARGET AREA:	AIRFIELD	1000 FT.
	OBJECTIVE:	ALL AIRCRAFT	
3.8	TARGET AREA:	GENERAL TERRAIN	1400 FT.
	OBJECTIVE:	TANKS	
2.0	TARGET AREA:	CANAL	2000 FT.
	OBJECTIVE:	LOCKS	
2.1	TARGET AREA:	HIGHWAY	2000 FT.
	OBJECTIVE:	ALL VEHICLES	
0.6	TARGET AREA:	AIRFIELD	2000 FT.
	OBJECTIVE:	ALL AIRCRAFT	
1.8	TARGET AREA:	HIGHWAY	2000 FT.
	OBJECTIVE:	TRACTOR TRAILER	
5.8	TARGET AREA:	RAIL	2000 FT.
	OBJECTIVE:	LOCOMOTIVES	
7.8	TARGET AREA:	GENERAL TERRAIN	1000 FT.
	OBJECTIVE:	ANY TARGET	
2.3	TARGET AREA:	GENERAL TERRAIN	1000 FT.
	OBJECTIVE:	ANY TARGET	

ROLL 2

SEGMENT LENGTH IN FEET	TASK DESCRIPTION		ALTITUDE
7.0	TARGET AREA: RIVER OBJECTIVE: SEAGOING SHIPS		2000 FT
5.3	TARGET AREA: CANAL OBJECTIVE: SEAGOING SHIPS		2000 FT.
3.4	TARGET AREA: AIRFIELD OBJECTIVE: ALL AIRCRAFT		2000 FT.
1.7	TARGET AREA: GENERAL TERRAIN OBJECTIVE: BRIDGES		2000 FT.
5.3	TARGET AREA: HIGHWAY OBJECTIVE: ALL VEHICLES		2000 FT.
0.7	TARGET AREA: AIRFIELD OBJECTIVE: ALL AIRCRAFT		2000 FT.
6.2	TARGET AREA: HIGHWAY OBJECTIVE: ALL VEHICLES		2000 FT.
5.9	TARGET AREA: RAIL OBJECTIVE: LOCOMOTIVES		1500 FT.
2.9	TARGET AREA: RAIL OBJECTIVE: LOCOMOTIVES		1500 FT.
21.6	TARGET AREA: RAIL OBJECTIVE: LOCOMOTIVES		2000 FT.
1.2	TARGET AREA: AIRFIELD OBJECTIVE: ALL AIRCRAFT		2000 FT.
0.8	TARGET AREA: RIVER OBJECTIVE: BRIDGES		2000 FT.
3.0	TARGET AREA: HIGHWAY OBJECTIVE: ALL VEHICLES		2000 FT.
1.5	TARGET AREA: HIGHWAY OBJECTIVE: ALL VEHICLES		2000 FT.
2.3	TARGET AREA: CANAL OBJECTIVE: LOCKS. WATERCRAFT		2000 FT.
4.6	TARGET AREA: AIRFIELD OBJECTIVE: ALL AIRCRAFT		2500 FT.
4.3	TARGET AREA: RAIL OBJECTIVE: LOCOMOTIVES		1000 FT.
1.3	TARGET AREA: SHORELINE OBJECTIVE: ANY TARGETS		2000 FT.
3.5	TARGET AREA: GENERAL TERRAIN OBJECTIVE: ANY TARGETS		2000 FT.

ROLL 3			
SEGMENT LENGTH IN FEET	TASK DESCRIPTION		ALTITUDE
1.4	TARGET AREA: AIRFIELD OBJECTIVE: FIGHTER AIRCRAFT		2000 FT.
3.2	TARGET AREA: GENERAL TERRAIN OBJECTIVE: ANY TARGETS		1500 FT.
3.2	TARGET AREA: GENERAL TERRAIN OBJECTIVE: BRIDGES		2000 FT.
2.8	TARGET AREA: CANAL OBJECTIVE: ALL WATERCRAFT		2000 FT.
2.2	TARGET AREA: GENERAL TERRAIN OBJECTIVE: BRIDGES		2000 FT.
3.9	TARGET AREA: GENERAL TERRAIN OBJECTIVE: ANY TARGETS		1500 FT.
2.2	TARGET AREA: GENERAL TERRAIN OBJECTIVE: ANY TARGETS		1000 FT.
9.3	TARGET AREA: GENERAL TERRAIN OBJECTIVE: GUN POSITIONS, FIRES		2000 FT.
6.1	TARGET AREA: GENERAL TERRAIN OBJECTIVE: ANY TARGETS		2000 FT.
5.2	TARGET AREA: GENERAL TERRAIN OBJECTIVE: ANY TARGETS		1500 FT.
1.8	TARGET AREA: GENERAL TERRAIN OBJECTIVE: GUN POSITIONS		1500 FT.
3.7	TARGET AREA: RIVER OBJECTIVE: SMALL BOATS		2000 FT.
5.2	TARGET AREA: RIVER OBJECTIVE: SEAGOING SHIPS		2000 FT.
3.5	TARGET AREA: RIVER OBJECTIVE: SMALL BOATS		2000 FT.
4.2	TARGET AREA: RIVER OBJECTIVE: SEAGOING SHIPS		2000 FT.
3.9	TARGET AREA: ROAD OBJECTIVE: ALL VEHICLES		1000 FT.
5.0	TARGET AREA: GENERAL TERRAIN OBJECTIVE: GUN POSITIONS, VEHICLES		1500 FT.
2.5	TARGET AREA: GENERAL TERRAIN OBJECTIVE: ANY TARGETS		1000 FT.
2.8	TARGET AREA: GENERAL TERRAIN OBJECTIVE: ANY TARGETS		1500 FT.
2.2	TARGET AREA: GENERAL TERRAIN OBJECTIVE: ANY TARGETS		1500 FT.

APPENDIX B

SUBJECT INSTRUCTIONS

INSTRUCTIONS FOR CONDITION A

Your task in this session will be to detect and identify targets in accordance with the specific mission instructions which precede each segment of film. While it is necessary to find all targets, due to the nature of these missions, it is just as important to be accurate.

To stress the importance of maintaining a balance between accuracy and completeness, your performance will be evaluated as follows: You will get one point for for each correct identification; however, you will also lose a point for each error you make. If you are not careful and make more errors than correct identifications, you may get a negative score.

Targets detected should be circled with a grease pencil and the identification of each target should be coded beside the circle. If more than one target is circled, the targets should be counted and their number written beside their identification. If the area is very dense with targets and you are confident there are more than 20, you should write +20 or 20+.

During this session you will not use the cursor or response panel to report location and identification. Also, you will not be able to vary or stop the film movement rate.

INSTRUCTIONS FOR CONDITION B

Your task in this session will be to detect, identify and locate targets in accordance with the specific mission instructions which precede each segment of film. While it is necessary to find all targets, due to the nature of these missions, it is just as important to be accurate.

To stress the importance of maintaining a balance between accuracy and completeness, your performance will be evaluated as follows: You will get one point for each correct identification; however, you will also lose a point for each error you make. If you are not careful and make more errors than correct identifications, you may get a negative score.

Targets detected should be circled with a grease pencil and the identification of each target should be coded beside the circle. If more than one target is circled, the targets should be counted and their number written beside the identification. If the area is very dense with targets and you are confident there are more than 20, you should write +20 or 20+.

During this session you will not use the cursor or response panel to report target location and identification, but instead will make a verbal report. For each target or cluster of targets circled, the closest 6 digit coordinate must be read from the bottom border of the imagery. This coordinate must be read aloud together with the target identification data to which it applies. For example, you might respond: "3 light aircraft and 2 helicopters at 036781." This report should be made while you are marking film with the grease pencil.

In this session you will not be able to vary or stop the film movement rate.

INSTRUCTIONS FOR CONDITION C

Your task in this session will be to detect, identify and locate targets in accordance with the specific mission instructions which precede each segment of film. While it is necessary to find all targets, due to the nature of these missions, it is just as important to be accurate.

To stress the importance of maintaining a balance between accuracy and completeness, your performance will be evaluated as follows: You will get one point for each correct identification; however, you will also lose a point for each error you make. If you are not careful and make more errors than correct identifications, you may get a negative score.

Targets detected should be circled with a grease pencil and the identification of each target should be coded beside the circle. If more than one target is circled, the targets should be counted and their number written beside the identification. If the area is very dense with targets and you are confident there are more than 20, you should write +20 or 20+.

During this session you will not use the cursor or response panel to report target location and identification, but instead will make a verbal report. For each target or cluster of targets circled, the closest 6 digit coordinate must read from the bottom border of the imagery. This coordinate must be read aloud together with the target identification data to which it applies. For example, you might respond: "3 light aircraft and 2 helicopters at 036781." This report should be made while you are marking film with the grease pencil.

You will be permitted to vary and stop the film movement rate as was demonstrated earlier; however, it is important that you remember to catch up and keep pace with the film input rate.

INSTRUCTIONS FOR CONDITION D

Your task in this session will be to detect, identify and locate targets in accordance with the specific mission instructions which precede each segment of film. While it is necessary to find all targets, due to the nature of these missions, it is just as important to be accurate.

To stress the importance of maintaining a balance between accuracy and completeness, your performance will be evaluated as follows: You will get one point for each correct identification; however, you will also lose a point for each error you make. If you are not careful and make more errors than correct identifications, you may get a negative score.

During this session you will use the cursor and response panel (as demonstrated) to locate and report targets of interest.

You will be permitted to vary and stop the film movement rate as was demonstrated earlier; however, it is important that you remember to catch up and keep pace with the film input rate.

INSTRUCTIONS FOR CONDITION E -- FIRST MAN

In this session you will function as the first man of a two-man team. Your task is simply to detect and identify targets in accordance with the mission instructions which precede each segment of film. After you are finished, you will exchange imagery with your partner and function as the second man using the film that he just finished.

As the first man of this team, you should attempt to be as accurate as possible. In other words, you should select only those targets that definitely are targets. Your partner will rescreen all the imagery to make sure you didn't miss any, but he will probably accept the targets that you found as real. Thus, if you note a false target, it will probably go through uncorrected and will count against your team.

Targets detected should be circled with a grease pencil and the identification of each target should be coded beside the circle. If more than one target is circled, the targets should be counted and their number written beside the identification. If the area is very dense with targets and you are confident there are more than 20, you may write +20 or 20+. There is no requirement to locate the targets you identify; the second man will supply coordinates while reporting your identifications.

In this session you will not be able to vary or stop the film movement rate.

INSTRUCTIONS FOR CONDITION E -- SECOND MAN

In this session you will function as the second man of a two-man team. Your partner went through the film previously and attempted to be as accurate as possible. In other words, he noted only those targets which definitely were targets. As the second man, you should rescreen the entire film to pick up any targets he may have missed.

In addition to rescreening the imagery, you must locate and report all targets (those that the first man found plus any additional one that you find), using the coordinate locator and the keyboard response panel. When reporting targets detected by the first man, you should also verify his identification and supply a proper identification if one is missing. You do not have to report targets identified by the first man if you think that they are false; however, remember that the first man emphasized accuracy in making these identifications so he probably is correct.

While it is necessary to find all targets, due to the nature of these missions, it is just as important to be accurate. To stress the importance of maintaining a balance between accuracy and completeness, your team's performance will be evaluated as follows: You will get one point for each correct identification; however, you will lost a point for each error you make. If you are not careful and make more errors than correct identifications, your team may get a negative score.

You will be permitted to vary and stop the film movement rate as was demonstrated earlier; however, it is important that you remember to catch up and keep pace with the film input rate.

INSTRUCTIONS FOR CONDITION F -- FIRST MAN

In this session you will function as the first man of a two-man team. Your task is simply to detect and identify targets in accordance with the mission instructions which precede each segment of film. After you are finished, you will exchange imagery with your partner and function as the second man using the film that he just finished.

As the first man of this team, you should try to be as complete as possible. In other words, you should make certain that all targets have been noted even if this means that a portion of the targets you select are errors or false images. It is extremely important that you pick up all targets since the second man will not research the imagery for additional targets. If a target is missed by you, it will also be missed by the team. Your partner will, however, study each of the targets you select to verify that they are real targets, and he probably will eliminate any false targets that have occurred. If counting all targets becomes too demanding during certain portions of the film, you should at least circle all suspected targets so they are not overlooked by the second man.

Targets detected should be circled with a grease pencil and the identification of each target should be coded beside the circle. If more than one target is circled, the targets should be counted and their number written beside the identification. If the area is very dense with targets and you are confident there are more than 20, you may write +20 or 20+. There is no requirement to locate the targets you identify; the second man will supply coordinates while reporting your identifications.

In this session, you will not be able to vary or stop the film movement rate.

INSTRUCTIONS FOR CONDITION F -- SECOND MAN

In this session you will function as the second man of a two-man team. Your partner previously went through the film and attempted to be as complete as possible. In other words, he noted all suspected targets with emphasis on completeness rather than accuracy. Since completeness was stressed, it is unlikely that any targets were missed. Errors, however, may have been made in the form of false targets circled and perhaps identified. As the second man, you should examine the targets detected by the first man and make certain that they are properly identified. Those that are not actual targets should be ignored.

In addition to verifying the targets detected and identified by the first man, you must locate and report all valid targets using the coordinate locator and keyboard response panel. Targets missed by the first man may be reported; however, since the first man emphasized completeness in making his detections, you should not spend extra time rescreening imagery between these detections.

While it is necessary to find all targets, due to the nature of these missions, it is just as important to be accurate. To stress the importance of maintaining a balance between accuracy and completeness, your team's performance will be evaluated as follows: You will get one point for each correct identification; however, you will lose a point for each error you make. If you are not careful and make more errors than correct identifications, your team may get a negative score.

You will be permitted to vary and stop the film movement rate as was demonstrated earlier; however, it is important that you remember to catch up and keep pace with the film input rate.

INSTRUCTIONS FOR CONDITION G -- FIRST MAN

In this session you will function as the first man of a two-man team. Your task is simply to detect and identify targets in accordance with the mission instructions which precede each segment of film. After you are finished, you will exchange imagery with your partner and function as the second man using the film that he just finished.

As the first man of this team, you should attempt to be as accurate as possible. In other words, you should select only those targets that definitely are targets. Your partner will rescreen all the imagery to make sure you didn't miss any, but he will probably accept the targets that you found as real. Thus, if you note a false target, it will probably go through uncorrected and will count against your team.

Targets detected should be circled with a grease pencil and the identification of each target should be coded beside the circle. If more than one target is circled, the targets should be counted and their number written beside the identification. If the area is very dense with targets and you are confident there are more than 20, you may write +20 or 20+. There is no requirement to locate the targets you identify, the second man will supply coordinates while reporting your identifications.

You will be permitted to vary and stop the film movement rate as was demonstrated earlier; however, it is important that you remember to catch up and keep pace with the film input rate.

INSTRUCTIONS FOR CONDITION G -- SECOND MAN

In this session you will function as the second man of a two-man team. Your partner went through the film previously and attempted to be as accurate as possible. In other words, he noted only those targets which definitely were targets. As the second man, you should rescreen the entire film to pick up any targets he may have missed.

In addition to rescreening the imagery, you must locate and report all targets (those that the first man found plus any additional one that you find), using the coordinate locator and the keyboard response panel. When reporting targets detected by the first man, you should also verify his identification and supply a proper identification if one is missing. You do not have to report targets identified by the first man if you think that they are false; however, remember that the first man emphasized accuracy in making these identifications so he probably is correct.

While it is necessary to find all targets, due to the nature of these missions, it is just as important to be accurate. To stress the importance of maintaining a balance between accuracy and completeness, your team's performance will be evaluated as follows: you will get one point for each correct identification; however, you will lose a point for each error you make. If you are not careful and make more errors than correct identifications, your team may get a negative score.

You will be permitted to vary and stop the film movement rate as was demonstrated earlier; however, it is important that you remember to catch up and keep pace with the film input rate.

INSTRUCTIONS FOR CONDITION H -- FIRST MAN

In this session you will function as the first man of a two-man team. Your task is simply to detect and identify targets in accordance with the mission instructions which precede each segment of film. After you are finished, you will exchange imagery with your partner and function as the second man using the film that he just finished.

As the first man of this team, you should try to be as complete as possible. In other words, you should make certain that all targets have been noted even if this means that a portion of the targets you select are errors or false images. It is extremely important that you pick up all targets since the second man will not rescreen the imagery for additional targets. If a target is missed by you, it will also be missed by the team. Your partner will, however, study each of the targets you select to verify that they are real targets, and he probably will eliminate any false targets that have occurred. If counting all targets becomes too demanding during certain portions of the film, you should at least circle all suspected targets so they are not overlooked by the second man.

Targets detected should be circled with a grease pencil and the identification of each target should be coded beside the circle. If more than one target is circled, the targets should be counted and their number written beside the identification. If the area is very dense with targets and you are confident there are more than 20, you may write +20 or 20+. There is no requirement to locate the targets you identify, the second man will supply coordinates while reporting your identifications.

You will be permitted to vary or stop the film movement rate as was demonstrated earlier; however, it is important that you remember to catch up and keep pace with the film input rate.

INSTRUCTIONS FOR CONDITION H -- SECOND MAN

In this session you will function as the second man of a two-man team. Your partner previously went through the film and attempted to be as complete as possible. In other words, he noted all suspected targets with emphasis on completeness rather than accuracy. Since completeness was stressed, it is unlikely that any targets were missed. Errors, However, may have been made in the form of false targets circled and perhaps identified. As the second man, you should examine the targets detected by the first man and make certain that they are properly identified. Those that are not actual targets should be ignored.

In addition to verifying the targets detected and identified by the first man, you must locate and report all valid targets using the coordinate locator and keyboard response panel. Targets missed by the first man may be reported; however, since the first man emphasized completeness in making his detections, you should not spend extra time rescreening imagery between these detections.

While it is necessary to find all targets, due to the nature of these missions, it is just as important to be accurate. To stress the importance of maintaining a balance between accuracy and completeness, your team's performance will be evaluated as follows: You will get one point for each correct identification; however, you will lose a point for each error you make. If you are not careful and make more errors than correct identifications, your team may get a negative score.

You will be permitted to vary and stop the film movement rate as was demonstrated earlier; however, it is important that you remember to catch up and keep pace with the film input rate.

APPENDIX C

ANALYSES OF VARIANCE AND DUNCAN'S MULTIPLE RANGE TEST

TABLE C-1 ANALYSES OF VARIANCE FOR ONE-MAN PERFORMANCE SCORES

C-1A DETECTION ACCURACY

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P
INTERPRETATION CONCEPT	248.59	3	82.86	.9270	
FILM SPEED	83.90	1	83.90	.9386	
INTERPRETATION CONCEPT X FILM SPEED	46.14	3	15.38	.1721	
ERROR (WITHIN)	3575.46	40	89.39		
TOTALS	3954.08	47			

C-1B IDENTIFICATION ACCURACY

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P.
INTERPRETATION CONCEPT	725.69	3	241.90	1.4678	
FILM SPEED	138.21	1	138.21	.8386	
INTERPRETATION CONCEPT X FILM SPEED	910.96	3	303.65	1.8425	
ERROR (WITHIN)	6592.24	40	164.81		
TOTALS	8367.11	47			

C-1C DETECTION COMPLETENESS

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P.
INTERPRETATION CONCEPT	371.27	3	123.76	.5066	
FILM SPEED	975.33	1	975.33	3.9923	
INTERPRETATION CONCEPT X FILM SPEED	236.01	3	78.67	.3220	
ERROR (WITHIN)	9772.13	40	244.30		
TOTALS	11354.75	47			

C-1D IDENTIFICATION COMPLETENESS

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P.
INTERPRETATION CONCEPT	589.28	3	196.43	1.0679	
FILM SPEED	1408.88	1	1408.88	7.6599	.01
INTERPRETATION CONCEPT X FILM SPEED	80.75	3	26.92	.1464	
ERROR (WITHIN)	7357.15	40	183.93		
TOTALS	9436.06	47			

C-1E CORRECTNESS

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P.
INTERPRETATION CONCEPT	1742.84	3	580.95	4.6677	.01
FILM SPEED	437.42	1	437.42	3.5145	
INTERPRETATION CONCEPT X FILM SPEED	855.10	3	285.03	2.2901	
ERROR (WITHIN)	4978.47	40	124.46		
TOTALS	8013.83	47			

TABLE C-2 ANALYSES OF VARIANCE FOR TWO-MAN PERFORMANCE SCORES

TABLE C-2A DETECTION ACCURACY

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F	P
INTERPRETATION CONCEPT	235.60	3	78.53	.8687	
FILM SPEED	.38	1	.38	.0042	
INTERPRETATION CONCEPT X FILM SPEED	124.54	3	41.51	.4592	
ERROR (WITHIN)	3616.22	40	90.41		
TOTALS	3976.74	47			

TABLE C-2b IDENTIFICATION ACCURACY

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P
INTERPRETATION CONCEPT	260.12	3	86.71	.7992	
FILM SPEED	26.20	1	26.20	.2414	
INTERPRETATION CONCEPT X FILM SPEED	447.99	3	149.33	1.3763	
ERROR (WITHIN)	4339.87	40	108.50		
TOTALS	5074.17	47			

TABLE C-2C DETECTION COMPLETENESS

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P.
INTERPRETATION CONCEPT	137.37	3	45.79	.2504	
FILM SPEED	2230.82	1	2230.82	12.1987	<.01
INTERPRETATION CONCEPT X FILM SPEED	180.65	3	60.22	.3293	
ERROR (WITHIN)	7314.93	40	182.87		
TOTALS	9863.77	47			

TABLE C-2D IDENTIFICATION COMPLETENESS

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P.
INTERPRETATION CONCEPT	95.14	3	31.71	.2533	
FILM SPEED	1992.41	1	1992.41	15.9120	<.01
INTERPRETATION CONCEPT X FILM SPEED	271.27	3	90.42	.7221	
ERROR (WITHIN)	5008.57	40	125.21		
TOTALS	7367.39	47			

TABLE C-2E CORRECTNESS

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P.
INTERPRETATION CONCEPT	116.69	3	38.90	.5575	
FILM SPEED	52.54	1	52.54	.7530	
INTERPRETATION CONCEPT X FILM SPEED	216.79	3	72.26	1.0356	
ERROR (WITHIN)	2791.07	40	69.78		
TOTALS	3177.09	47			

TABLE C-3 ANALYSES OF VARIANCE FOR ONE-MAN PERFORMANCE/TIME SCORES

TABLE C-3A DETECTION ACCURACY

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P
INTERPRETATION CONCEPT	5.77	3	1.92	14.581703	.01
FILM SPEED	34.01	1	34.01	257.996596	.01*
INTERPRETATION CONCEPT X FILM SPEED	2.52	3	.84	6.366731	.01
WITHIN TREATMENTS	5.27	40	.13		
TOTAL	47.57	47			

TABLE C-3B IDENTIFICATION ACCURACY

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P.
INTERPRETATION CONCEPT	1.25	3	.42	1.916899	
FILM SPEED	15.24	1	15.24	70.227880	01*
INTERPRETATION CONCEPT X FILM SPEED	.38	3	.13	.590757	
WITHIN TREATMENTS	8.68	40	.22		
TOTAL	25.56	47			

TABLE C-3C DETECTION COMPLETENESS

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P.
INTERPRETATION CONCEPT	3.39	3	1.13	5.624991	.01
FILM SPEED	6.57	1	6.57	32.673863	.01*
INTERPRETATION CONCEPT X FILM SPEED	1.74	3	.58	2.882884	.05
WITHIN TREATMENTS	8.04	40	.20		
TOTAL	19.74	47			

TABLE C-3D IDENTIFICATION COMPLETENESS

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P.
INTERPRETATION CONCEPT	1.69	3	[illegible]	3.923467	.05
FILM SPEED	2.52	1	2.52	17.516679	.01*
INTERPRETATION CONCEPT X FILM SPEED	.57	3	.19	1.331810	
WITHIN TREATMENTS	5.75	40	.14		
TOTAL	10.54	47			

TABLE C-3E CORRECTNESS

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P.
INTERPRETATION CONCEPT	2.32	3	.77	3.678644	.05
FILM SPEED	18.83	1	18.83	89.454825	.01*
INTERPRETATION CONCEPT X FILM SPEED	.91	3	.30	1.435831	
WITHIN TREATMENTS	8.42	40	.21		
TOTAL	30.48	47			

TABLE C-4 ANALYSES OF VARIANCE FOR TWO-MAN PERFORMANCE/COMPOSITE TIME

TABLE C-4A DETECTION ACCURACY

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F	P
INTERPRETATION CONCEPT	.1967	3	.0656	1582	
FILM SPEED	8.2641	1	8.2641	19.9416	.01*
INTERPRETATION CONCEPT X FILM SPEED	1.0821	3	.3607	.8704	
ERROR (WITHIN)	16.5765	40	.4144		
TOTALS	26.1194	47			

TABLE C-4B IDENTIFICATION ACCURACY

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P
INTERPRETATION CONCEPT	.1233	3	.0411	.1319	
FILM SPEED	5.1273	1	5.1273	16.4506	.01*
INTERPRETATION CONCEPT X FILM SPEED	.7088	3	.2363	.7580	
ERROR (WITHIN)	12.4672	40	.3117		
TOTALS	18.4266	47			

TABLE C-4C DETECTION COMPLETENESS

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P.
INTERPRETATION CONCEPT	.0156	3	.0052	.0226	
FILM SPEED	.3993	1	.3993	1.7390	
INTERPRETATION CONCEPT X FILM SPEED	.2101	3	.0700	.3050	
ERROR (WITHIN)	9.1857	40	.2296		
TOTALS	9.8107	47			

TABLE C-4D IDENTIFICATION COMPLETENESS

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F.	P.
INTERPRETATION CONCEPT	.0171	3	.0057	.0405	
FILM SPEED	.1545	1	.1545	1.0997	
INTERPRETATION CONCEPT X FILM SPEED	.1490	3	.0497	.3533	
ERROR (WITHIN)	5.6212	40	.1405		
TOTALS	5.9418	47			

TABLE C-4E CORRECTNESS

SOURCE OF VARIATION	SUM OF SQUARES	D.F.	MEAN SQUARE	F	P.
INTERPRETATION CONCEPT	.6181	3	.2060	.5370	
FILM SPEED	7.3245	1	7.3245	19.0911	.01*
INTERPRETATION CONCEPT X FILM SPEED	1.0825	3	.3608	.9405	
ERROR (WITHIN)	15.3464	40	.3837		
TOTALS	24.3715	47			

TABLE C-5 DUNCAN'S MULTIPLE RANGE TEST - ONE-MAN PERFORMANCE

TABLE C-5A DETECTION ACCURACY

		D	A	B	C	SHORTEST SIGNIFICANT RANGE
	MEANS	83.89	84.67	86.57	89.79	
D	83.89	–	.78	2.68	5.90	R_2 7.082
A	84.67	–	–	1.90	5.12	R_3 8.206
B	86.57	–	–	–	3.22	R_4 8.468

TABLE C-5B IDENTIFICATION ACCURACY

		B	C	A	D	SHORTEST SIGNIFICANT RANGE
	MEANS	63.68	68.94	70.21	74.59	
B	63.68	–	5.26	6.53	10.91	R_2 10.592
C	68.94	–	–	1.27	5.65	R_3 11.140
A	70.21	–	–	–	4.38	R_4 11.496

TABLE C-5C DETECTION COMPLETENESS

		D	B	C	A	SHORTEST SIGNIFICANT RANGE
	MEANS	50.10	51.23	52.76	57.40	
D	50.10	–	1.13	2.66	7.30	R_2 12.895
B	51.23	–	–	1.53	6.17	R_3 13.563
C	52.76	–	–	–	4.64	R_4 13.996

TABLE C-5D IDENTIFICATION COMPLETENESS

		B	C	D	A	SHORTEST SIGNIFICANT RANGE
	MEANS	38.38	40.65	43.74	47.72	
B	38.38	–	2.27	5.36	9.34	R_2 11.169
C	40.65	–	–	3.09	7.07	R_3 11.768
D	43.74	–	–	–	3.98	R_4 12.144

TABLE C-5E CORRECTNESS

		B	C	A	D	SHORTEST SIGNIFICANT RANGE
	MEANS	73.38	76.69	83.59	88.95	
B	73.38	–	3.31	10.21*	15.57*	R_2 9.206
C	76.69	–	–	6.90	12.26*	R_3 9.682
A	83.59	–	–	–	5.36	R_4 9.992

* $P < .05$

TABLE C-6 DUNCAN'S MULTIPLE RANGE TEST - TWO-MAN PERFORMANCE

TABLE C-6A DETECTION ACCURACY

		F	E	G	H	SHORTEST SIGNIFICANT RANGE
	MEANS	80.12	83.13	85.17	85.80	
F	80.12	–	3.01	5.05	5.68	R_2 7.845
E	83.13	–	–	2.04	2.67	R_3 8.251
G	85.17	–	–	–	.63	R_4 8.515

TABLE C-6B IDENTIFICATION ACCURACY

		E	F	G	H	SHORTEST SIGNIFICANT RANGE
	MEANS	68.24	68.90	71.90	74.02	
E	68.24	–	.66	3.66	5.78	R_2 8.594
F	68.90	–	–	3.00	5.12	R_3 9.039
G	71.90	–	–	–	2.12	R_4 9.328

TABLE C-6C DETECTION COMPLETENESS

		F	E	H	G	SHORTEST SIGNIFICANT RANGE
	MEANS	51.19	52.73	53.60	55.87	
F	51.19	–	1.54	2.41	4.68	R_2 11.158
E	52.73	–	–	.87	3.14	R_3 11.735
H	53.60	–	–	–	2.27	R_4 12.110

TABLE C-6D IDENTIFICATION COMPLETENESS

		E	F	H	G	SHORTEST SIGNIFICANT RANGE
	MEANS	43.54	43.83	45.95	46.88	
E	43.54	–	.29	2.41	3.34	R_2 9.232
F	43.83	–	–	2.12	3.05	R_3 9.710
G	45.95	–	–	–	.93	R_4 10.021

TABLE C-6E CORRECTNESS

		E	G	F	H	SHORTEST SIGNIFICANT RANGE
	MEANS	82.42	84.17	85.68	86.52	
E	82.42	–	1.75	3.26	4.10	R_2 6.891
G	84.17	–	–	1.51	2.35	R_3 7.247
F	85.68	–	–	–	.84	R_4 7.479

TABLE C-7 DUNCAN'S MULTIPLE RANGE TEST - ONE-MAN PERFORMANCE TIME

TABLE C 7A DETECTION ACCURACY 5 IPS

		D	C	A	B	SHORTEST SIGNIFICANT RANGE
	MEANS	1.66	1.91	1.91	1.95	
D	1.66	–	.25	.25	.29	R_2 .420
C	1.91	–	–	–	.04	R_3 .442
A	1.95	–	–	–	.04	R_4 .456

TABLE C-7B DETECTION ACCURACY 1.0 IPS

		D	C	A	B	SHORTEST SIGNIFICANT RANGE
	MEANS	2.56	3.75	3.85	4.01	
D	2.56	–	1.19*	1.29*	1.45*	R_2 .420
C	3.75	–	–	.10	.26	R_3 .442
A	3.85	–	–	–	.16	R_4 .456

TABLE C-7C IDENTIFICATION ACCURACY

		D	B	C	A	SHORTEST SIGNIFICANT RANGE
	MEANS	1.89	2.11	2.13	2.35	
D	1.89	–	.22	.24	.46*	R_2 .384
B	2.11	–	–	.02	.24	R_3 .404
C	2.13	–	–	–	.22	R_4 .417

TABLE C-7D DETECTION COMPLETENESS .5 IPS

		D	C	B	A	SHORTEST SIGNIFICANT RANGE
	MEANS	1.12	1.23	1.25	1.33	
D	1.12	-	.11	.13	.21	R_2 = .522
C	1.23	-	-	.02	.10	R_3 .550
B	1.25	-	-	-	.08	R_4 = .566

*P< .05

TABLE C-7 DUNCAN'S MULTIPLE RANGE TEST - ONE-MAN PERFORMANCE TIME (CONT'D)

TABLE C-7E DETECTION COMPLETENESS 1.0 IPS

		D	C	B	A	SHORTEST SIGNIFICANT RANGE
	MEANS	1.25	1.98	2.17	2.49	
D	1.25	-	.73*	.92*	1.24*	R_2 .522
C	1.98	-	-	.19	.51	R_3 .550
B	2.17	-	-	-	.32	R_4 .566

TABLE C-7F IDENTIFICATION COMPLETENESS

		D	C	B	A	SHORTEST SIGNIFICANT RANGE
	MEANS	1.05	1.21	1.23	1.56	
D	1.05	-	.16	.18	.51*	R_2 .313
C	1.21	-	-	.02	.35*	R_3 .329
B	1.23	-	-	-	.33*	R_4 .340

TABLE C-7-G CORRECTNESS

		D	C	B	A	
	MEANS	2.23	2.37	2.41	2.82	
D	2.23	-	.14	.18	.59*	R_2 378
C	2.37	-	-	.04	.45*	R_3 398
B	2.41	-	-	-	.41*	R_4 411

* $P<.05$

TABLE C-8 DUNCAN'S MULTIPLE RANGE TEST - TWO-MAN PERFORMANCE COMPOSITE TIME

TABLE C-8A DETECTION ACCURACY

		G	H	F	E	SHORTEST SIGNIFICANT RANGE
	MEANS	2.05	2.08	2.18	2.20	
G	2.05	-	.03	.13	.15	R_2 .531
H	2.08	-	-	.10	.12	R_3 .559
F	2.18	-	-	-	.02	R_4 .576

TABLE C-8B IDENTIFICATION ACCURACY

		G	H	E	F	SHORTEST SIGNIFICANT RANGE
	MEANS	1.74	1.77	1.78	1.88	
G	1.74	-	.03	.04	.14	R_2 .461
H	1.77	-	-	.01	.11	R_3 .484
E	1.78	-	-	-	.10	R_4 .499

TABLE C-8C DETECTION COMPLETENESS

		H	G	F	E	SHORTEST SIGNIFICANT RANGE
	MEANS	1.30	1.33	1.34	1.35	
H	1.30	-	.03	.04	.05	R_2 .395
G	1.33	-	-	.01	.02	R_3 .416
F	1.34	-	-	-	.01	R_4 .429

TABLE C-8D IDENTIFICATION COMPLETENESS

		E	H	G	F	SHORTEST SIGNIFICANT RANGE
	MEANS	1.10	1.10	1.11	1.14	
E	1.10	-	.00	.01	.04	R_2 = .309
H	1.10	-	-	.01	.04	R_3 = .325
G	1.11	-	-	-	.03	R_4 = .336

TABLE C-8E CORRECTNESS

		G	H	E	F	SHORTEST SIGNIFICANT RANGE
	MEANS	2.04	2.07	2.16	2.33	
G	2.04	-	.03	.12	.29	R_2 = .511
H	2.07	-	-	.09	.26	R_3 .537
E	2.16	-	-	-	.17	R_4 = .555